

WHAT IS CLAIMED IS:

- 1 1. A power device, comprising:
2 a gate electrode, a source electrode, and a drain electrode provided within
3 an active region of a semiconductor substrate of first conductivity type; and
4 a vertical diffusion region of second conductivity provided at a periphery
5 the active region, the vertical diffusion region extending continuously from a top surface
6 of the substrate to a bottom surface of the substrate, the vertical diffusion region
7 including:
8 an upper portion having a first depth, and
9 a lower portion having a second depth that is substantially greater
10 than the first depth.
- 1 2. The power device of claim 1, wherein the power device is an IGBT
2 device.
- 1 3. The power device of claim 1, wherein the vertical frame is a scribe
2 diffusion region.
- 1 4. The power device of claim 1, wherein the upper portion primarily
2 comprises of an impurity of first type and the lower portion comprises of an impurity of
3 second type different from the impurity of first type.
- 1 5. The power device of claim 4, wherein the impurity of first type has
2 a first diffusion rate and the impurity of second type has a second diffusion rate, the
3 second diffusion rate being greater than the first diffusion rate.
- 1 6. The power device of claim 5, wherein the impurity of first type is
2 boron.
- 1 7. The power device of claim 6, wherein the impurity of second type
2 is aluminum.
- 1 8. The power device of claim 1, wherein the first depth of the upper
2 portion is less than about 70% of the second depth of the lower portion.
- 1 9. The power device of claim 8, wherein the first depth of the upper
2 portion is about 50% of the second depth of the lower portion.

1 10. The power device of claim 1, wherein the vertical diffusion frame
2 provides forward and reverse blocking capabilities.

1 11. A power device; comprising:
2 a gate region, a source region, and a drain region provided in an active
3 region of a semiconductor substrate of first conductivity type, the substrate having a front
4 side and a backside;
5 a scribe diffusion region of second conductivity type provided around the
6 active region, the scribe diffusion region extending continuously from the front side of the
7 substrate to the backside of the substrate, the scribe diffusion region comprising an
8 impurity of first type and an impurity of second type different from the impurity of first
9 type.

1 12. The power device of claim 11, the scribe diffusion region including
2 a first portion adjacent to the front side of the substrate and a second portion adjacent to
3 the backside of the substrate, the first portion primarily comprising the impurity of first
4 type and the second portion primarily comprising the impurity of second type.

1 13. The power device of claim 11, wherein the scribe diffusion region
2 provides the power device with substantially symmetrical forward and reverse blocking
3 ratings.

1 14. The power device of claim 11, wherein the impurity of first type is
2 boron and the impurity of second type is aluminum.

1 15. The power device of claim 11; further comprising:
2 a plurality of wells of second conductivity provided within the active
3 region of the substrate, the plurality of wells having an impurity of third type.

1 16. The power device of claim 15, wherein a diffusion rate of the
2 impurity of second type is greater than that of the impurity of third type.

1 17. The power device of claim 11, wherein the substrate of first
2 conductivity is an N type substrate, and the scribe diffusion region of second conductivity
3 is a P type region.

1 18. A method for fabricating a power device, comprising:
 2 providing a substrate of first conductivity, the substrate having a front side
 3 and a backside;
 4 forming a scribe diffusion region of second conductivity at a periphery of
 5 the substrate, the scribe diffusion region extending continuously from the front side to the
 6 backside of the substrate, wherein the scribe diffusion region includes an impurity of first
 7 type and an impurity of second type that is different than the impurity of first type.

1 19. The method of claim 18, further comprising:
 2 providing a peripheral impurity region at a first scribe area on the front
 3 side of the substrate, the peripheral impurity region being provided with the impurity of
 4 first type; and
 5 providing the impurity of second type at a second scribe area on the
 6 backside of the substrate.

1 20. The method of claim 18, wherein a concentration of the impurity of
 2 first type at the peripheral impurity region is between about 10^{19} to 10^{20} atoms/cm³.

1 21. A method for fabricating a power device, comprising:
 2 providing a substrate of first conductivity, the substrate having a front side
 3 and a backside;
 4 forming an aluminum structure at a scribe area on the backside of the
 5 substrate; and
 6 placing the substrate having the aluminum structure in an environment
 7 with a first temperature that is less than the melting point of aluminum to prevent the
 8 aluminum structure from melting.

1 22. The method of claim 21, wherein the environment has oxygen to
 2 convert the aluminum structure into an aluminum oxide structure.

1 23. The method of claim 22, wherein the environment is an inside of a
 2 furnace.

1 24. The method of claim 23, further comprising:

- 2 increasing the temperature of the environment to over 1000 degree
- 3 Celsius; and
- 4 leaving the substrate within the environment until aluminum atoms have
- 5 diffused to at least a midpoint between the front and back sides of the substrate.

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